

# *In-Situ* Processing of Superconducting MgB<sub>2</sub>-Metal Composites

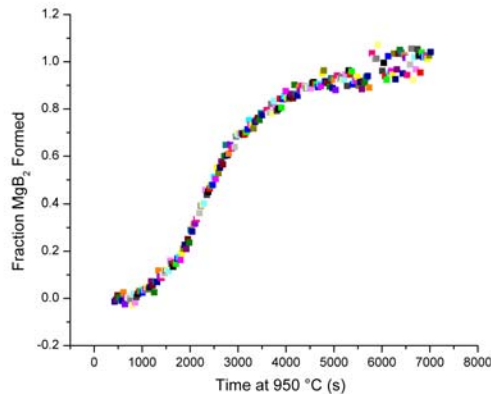
David C. Dunand, Northwestern University, DMR-0233805

## Motivation

MgB<sub>2</sub> is a newly discovered superconductor with a relatively high T<sub>c</sub> of 39 K. We are studying its low-cost synthesis according to:



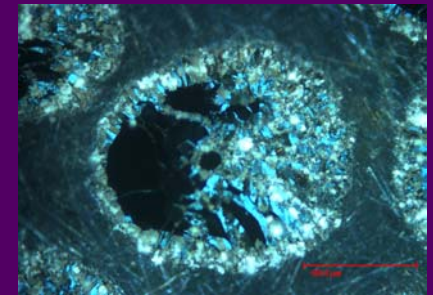
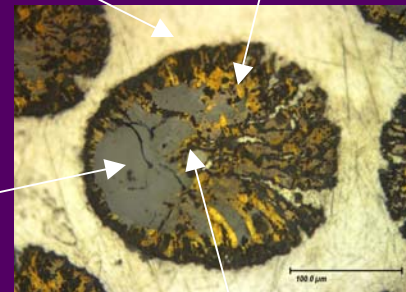
## Kinetics Study



A reaction vs. time curve was generated by reacting Mg liquid and B fibers (140  $\mu\text{m}$  in diameter) in a sealed titanium crucible at 950 °C and monitoring the MgB<sub>2</sub> formation using high energy scattering of synchrotron x-rays at Argonne National Lab.

Mg matrix      MgB<sub>2</sub> reaction product

Unreacted Boron

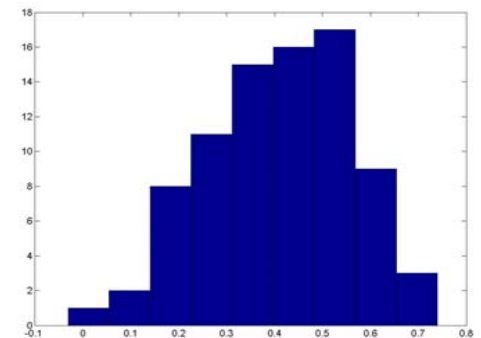


W-B Core

MgB<sub>2</sub> birefringence under cross-polarized light

Using optical microscopy with cross-polarized light, the B was distinguishable from the reacted MgB<sub>2</sub> and the fraction of reacted MgB<sub>2</sub> calculated for several fibers in a sample.

Histograms of the fraction of MgB<sub>2</sub> formed for individual fibers shows that large fiber-to-fiber differences exist. This information is complementary to the average fraction shown on the left graph.



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## **Broad Impact:**

- Synchrotron radiation experiments were performed at the DuPont-Northwestern-Dow Collaborative Access Team (DND-CAT) Synchrotron Research Center at the Advanced Photon Source, Argonne National Laboratory. Publication will have ANL co-author.
- A recently published article (*Applied Physics Letters*, vol. **83**, 120-122 (2003)) was highlighted in the general-public journal *Advanced Materials & Processes* (vol. 161, 2003) under their heading “Materials Progress”.

## **Education:**

One graduate student and two undergraduate students were involved in this work.

- The microstructural analysis work was done in collaboration with the Materials Research Center’s Research Experience for Undergraduates (REU) program at Northwestern University during the summer of 2003. Greg LeMay (currently a senior at the University of Pennsylvania) developed and completed the analysis of several composites.
- Nirand Pisutha-Arnond, a junior undergraduate student at Northwestern University, has worked extensively on MgB<sub>2</sub> composites during 2003 and contributed to this work through preparing samples that were used for both the microstructural and synchrotron studies.
- Graduate student John DeFouw mentored Greg and Nirand in their work and conducted the kinetics study at the Advanced Photon Source.